Agriculture and Forestry Sector: Nitrogen Reduction

- Iowa

Reducing Nitrogen Fertilizer Use

Iowa's extensive programs to reduce pesticide and fertilizer use were born out of a desire to reduce groundwater contamination but grew to include the protection of all waters. Streams in Iowa have among the highest nitrogen and phosphorous levels in the country and may contribute one-fourth of all the nitrates washed into the Gulf of Mexico each year. Beginning in 1982, a series of research and demonstration programs have encouraged farmers to reduce their fertilizer use to improve profit margins and help the environment. In 1987, these programs, developed by numerous organizations, were expanded into the statewide Integrated Farm Management Demonstration Project and the Model Farms Demonstration Project. Funding for these programs expired in 1993, but they continue to have a profound effect on fertilization practices in Iowa. Collectively known as the Iowa Agricultural-Energy-Environmental Initiative, these programs succeeded in reducing the 1998 nitrogen application rate on corn by 12.5% over the 1985 application rate. In addition to reducing groundwater contamination, farmers achieved lower production costs. It was estimated that every dollar invested in the project returned more than fifteen dollars in savings.

Reduction of nitrogen fertilizer application acts in two ways to reduce greenhouse gas emissions. First, a small percentage of the nitrogen applied to the soil gets directly converted to nitrous oxide (N_2O), a powerful greenhouse gas. Second, fertilizers and pesticides derived from fossil fuels make up 75% of the energy inputs in Iowa corn production. By reducing the amount of fertilizer applied, Iowa farmers reduce the amount of energy used to manufacture, ship, and spread fertilizer to their fields each year.

Results:

Cost Savings	Greenhouse Gas Reductions
$32.4 million	163,000 MTCE*/yr

In 1998, 12.5 million acres of corn were planted in Iowa. Of this area, 96% was treated with commercial nitrogen-based fertilizers. The average fertilizer application rate was 127 lbs nitrogen (N) per acre, down from 145 lbs N per acre in 1985 (a 12% reduction). This rate is 18% less than the rate in surrounding Corn Belt states, which applied an average of 154 lbs N per acre. Despite this drop in nitrogen application, corn yields in Iowa were higher than those in the surrounding states. In 1998, Iowa averaged a corn yield of 145 bushels per acre while other Corn Belt states averaged a yield of 136 bushels per acre.

The lower application rate translates to a savings of 216 million lbs of nitrogen. This is equivalent to a N_2O savings of 1,900 metric tons* of N_2O or in terms of CO_2 equivalents a savings of 597,000 metric tons* (163,000 MTCE*). At a fertilizer price of 15 cents per lb N, the lower application rate saved $32.4 million. Although it is difficult to quantify the energy savings associated with the application of less fertilizer, best estimates indicate that the energy required to manufacture, transport, store, and apply five pounds of nitrogen is equivalent of one gallon of diesel fuel (based on Btu equivalency). Thus, in 1998, lower application rates saved the equivalent of 43.2 million gallons of diesel fuels**.

Principal Actors:

The Iowa State University Agronomy Department developed the programs through the Agricultural Energy Management Program. The initiative was financed primarily through oil overcharge funds and the Iowa Groundwater Protection Act funds administered by the Iowa Department of Natural Resources. Many other organizations collaborated in implementing these programs and contributed to their success.

Additional Information:

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This case study is based on information provided by Craig Stark, Iowa Department of Natural Resources and downloaded from the Iowa State University Department of Agronomy website: http://extension.agron.iastate.edu/soils/nuse.html.

*Original data have been converted from tons nitrogen applied to metric tons of carbon equivalent (MTCE) based on conversion formulas from the *1999 Emission Inventory Improvement Program Volume XIII* as follows:

$$tons\ N\ applied \times \frac{0.0125\ tons\ N\ emitted}{tons\ N\ applied} \times \frac{44\ tons\ N_2O}{28\ tons\ N\ emitted} \times \frac{310\ tons\ CO_2\ equiv}{tons\ N_2O} \times \frac{12\ tons\ C}{44\ tons\ CO_2}$$

**This energy data has not been converted to CO_2 savings because it represents estimated energy savings from a variety of different fuels based on BTUs (British thermal units). Because carbon intensity per Btu varies significantly between fuel types, it is difficult to obtain a meaningful value of CO_2 savings from this type of estimate. It is included as an indication that the agricultural management programs have achieved significant energy savings as well as nitrogen savings.